

SOIL MOISTURE PATHFINDER

A Low-Cost Passive Spaceborne System Using Inflatable Structures¹

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ABSTRACT

The Soil Moisture Pathfinder is a new, low-cost mission concept for measurement of soil moisture from space. Recent advances in the technology of inflatable structures make possible the spaceborne deployment and operation of large-aperture, low-mass, and low-cost antennas suitable for soil moisture remote sensing in the L- and S-band frequency range. The concept presented here is the result of a detailed design study, and has evolved from a number of previous studies of large-aperture antenna systems for Earth science applications.

The mission concept centers on an inflatable, offset-fed, parabolic-torus antenna with radiometers at its foci located at the annular focus of the reflector. The foci generate independent, fixed, conically-distributed beams, with a constant incidence angle at the Earth's surface. The system operates at 1.4 and 2.65 GHz frequencies, with horizontal and vertical polarizations, providing four independent data channels. The multiple-beam configuration, coupled with the along-track spacecraft motion, results in a pushbroom mode of operation. This provides a unique capability for multichannel (frequency and polarization), wide-swath, and high radiometric precision mapping of the surface. Multichannel capability is required for accurate estimation of soil moisture in the presence of variable vegetation cover and other surface features. The wide-swath capability enables complete global coverage to be obtained every 2 to 3 days which is desired for soil moisture applications. The radiometric precision and calibration stability afforded by the system provide the potential for high accuracy and repeatability of the soil moisture measurements.

The Soil Moisture Pathfinder design builds on the experience of the Inflatable Antenna Experiment which flew successfully on Space Shuttle Endeavor (STS-77) in May 1996, and incorporates recent advances in multifunctional structures and Microwave Monolithic Integrated Circuits (MMIC) technology developed in part through NASA's New Millennium Program.

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